

582 LECTURE NOTES IN ECONOMICS
AND MATHEMATICAL SYSTEMS

Jochen Andritzky

Sovereign Default Risk Valuation

Implications of Debt Crises
and Bond Restructurings

 Springer

Lecture Notes in Economics and Mathematical Systems

582

Founding Editors:

M. Beckmann
H.P. Künzi

Managing Editors:

Prof. Dr. G. Fandel
Fachbereich Wirtschaftswissenschaften
Fernuniversität Hagen
Feithstr. 140/AVZ II, 58084 Hagen, Germany

Prof. Dr. W. Trockel
Institut für Mathematische Wirtschaftsforschung (IMW)
Universität Bielefeld
Universitätsstr. 25, 33615 Bielefeld, Germany

Editorial Board:

A. Basile, A. Drexler, H. Dawid, K. Inderfurth, W. Kürsten, U. Schittko

Jochen Andritzky

Sovereign Default Risk Valuation

Implications of Debt Crises and
Bond Restructurings

With 43 Figures
and 49 Tables

 Springer

Jochen Andritzky
6432 Divine St
McLean, VA 22101
USA
jochen@andritzky.com

ISBN-10 3-540-37448-5 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-37448-0 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media
springeronline.com

© Springer Berlin Heidelberg 2006

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Typesetting: Camera ready by author

Cover: Erich Kirchner, Heidelberg

Production: LE-TEX, Jelonek, Schmidt & Vöckler GbR, Leipzig

SPIN 11818731 Printed on acid-free paper – 88/3100 – 5 4 3 2 1 0

Preface

When politics meet economics, history has taught that standard concepts of welfare maximization and efficiency take a back seat. And if financial theory by itself were to guide investment decisions, empirical finance could not produce new findings. Combine politics and economics, theoretical and empirical finance, and add some spice from dynamically developing markets, and you end up valuing emerging market sovereign bonds. The monograph at hand approaches this challenge. I am grateful for all the support and advice that I received during this ambitious project.

First let me thank my advisors at the University of St. Gallen, Klaus Spremann and Paul Söderlind, who offered me the opportunity to join the Swiss Institute for Banking and Finance (s/bf) for fruitful years of research and who supported my academic progress. I also thank Kenneth Kletzer and Michael Dooley of the University of California, Santa Cruz, for hosting me as a visiting scholar and providing straightforward advice on my work. My research abroad was made possible through the sponsorship of the Swiss National Fund, for which I am most grateful.

As with most academic studies, this monograph has benefitted greatly from the comments of others. Foremost, I thank Manmohan Singh from the International Monetary Fund (IMF) whose good sense of financial markets provided a refreshing antidote to my predominantly theoretical perspective. With his input and his extensive contacts among market insiders two joint working papers came into being, thus establishing the basis for Chap. 6. Furthermore, I thank Bojan Bistrovic for his thoughts on many mathematical issues.

A summer spent at the IMF in 2004 became a very fruitful catalyst for my research. I would like to thank everyone who made this possible. The resulting IMF working paper constitutes an excellent complement

to this monograph and helped me gauge the fundamental drivers of sovereign bond risk. Hence I owe a debt of gratitude to my co-authors, Natalia Tamirisa from the Policy Development and Review Department and Geoffrey Bannister from the International Capital Markets Department, as well as to my advisor Martine Guerguil. Many contacts from that time have provided helpful guidance and have given rise to important discussions transcending the scope of this dissertation. For their inspiration I would like to thank Axel Bertuch-Samuels, Peter Breuer, Jorge Chan-Lau, Norbert Funke, and Alexander Plekhanov. Frank Packer and Haibin Zhu from the Bank for International Settlements contributed valuable comments to Chap. 6. Raúl Javaloyes from the UNCTAD gave me helpful insight into debt management tools. Alvin Ying from JP Morgan Chase always responded instantly to data requests.

Profound thanks, too, are due to my colleagues at my home university in Switzerland who not only made the time there so enjoyable but also provided crucial support in the early stages of this project. Helpful comments were also received from the conferences of the German Economic Association, the Swiss Society for Financial Market Research, the Irish Economic Association, and the Quant Congress USA, as well as from seminar participants at the universities in St. Gallen and Santa Cruz, the IMF, and the Thurgau Institute of Economics. For helping me revise this monograph on short notice I wish to thank Veronica Schmiedeskamp, David Kaun, William Koch, and Andrew Verner.

Words do not suffice to describe the support of my wife Juliane. During all stages of the dissertation she gave me invaluable emotional backing and helpful advice to steer me through the adversities of a young academic career. It was she who always stood by my side and who willingly tolerated never ending working hours.

St. Gallen, January 2006

List of Symbols

B	Value of money market account
C	Coupon payment
c	Annual CDS premium
D	Macauley duration
d	Stochastic discount factor
F	Forward rate
g	Premium leg
h	Protection leg
L	Average life
N	Notional value
P	Risky coupon bond price
Q	Cumulative distribution function of the default probability
q	Unconditional default function
R	Recovery adjusted discount rate
r	Instantaneous risk-free rate
S	Survival function
s	Continuous risk spread
Y	Annual yield
y	Continuous yield
Z	Risky zero bond price
Λ	Risk-neutral binary hazard rate process
λ	Hazard function
φ	Total recovery value
ψ	Recovery fraction of market value (RMV)
ω	Recovery fraction of face value (RFV)
τ	Credit event time

Contents

1	Introduction	1
1.1	Relevance of the Topic	3
1.1.1	Relevance for Global Investment	3
1.1.2	Relevance for Emerging Countries	5
1.1.3	Relevance in Academic Research	8
1.2	Research Subject and Methodology	9
1.2.1	Subject	9
1.2.2	Methodology	12
1.2.3	Structure	13
2	Sovereign Lending and Default	15
2.1	The pre-1990 Episode of Sovereign Lending	17
2.1.1	Infancy and the “Golden Age”	17
2.1.2	Bank Loans and Restructuring	19
2.1.3	The Brady Plan	21
2.2	The post-1990 Episode of Sovereign Lending	22
2.2.1	Mexico 1994–1995	28
2.2.2	The Asian Crisis 1996–1997	29
2.2.3	Russia 1997–1998	30
2.2.4	Brazil 1998–1999, 2002–2003	31
2.2.5	Pakistan 1998–1999	32
2.2.6	Ecuador 1998–1999	33
2.2.7	Ukraine 1998–2000	34
2.2.8	Turkey 2000–2001	35
2.2.9	Argentina 2000–2005	36
2.2.10	Uruguay 2001–2003	38
2.2.11	Moldova 2002	39
2.2.12	The Caribbean Restructurings 2005–2006	40

2.2.13 Outlook	41
2.3 The Theory of Sovereign Lending and Default	42
2.3.1 The Theory of Lending	43
2.3.2 Crisis Literature	45
2.3.3 The Literature on the IMF’s Role	47
2.4 Empirical Evidence	49
2.4.1 Determinants of Crises	50
2.4.2 The Effect of IMF Involvement	52
2.4.3 Determinants of Ratings	54
2.4.4 Determinants of Spreads	55
2.5 Concluding Remarks	58
3 Sovereign Restructuring	61
3.1 Literature Review	62
3.1.1 Sovereign Bankruptcy Procedures	62
3.1.2 Analyzing Past Workouts	68
3.2 Crisis Resolution in a Nutshell	69
3.2.1 Liquidity and Solvency Crises	69
3.2.2 Debt Swap, Soft and Hard Restructurings	71
3.3 Evidence From Recent Restructurings	78
3.3.1 Features of Recent Restructurings	80
3.3.2 Resulting Present Value	88
3.4 Lessons for Investors	96
3.4.1 Investor Returns	96
3.4.2 Modeling the Recovery Value	101
3.5 Concluding Remarks	105
4 Modeling Sovereign Default Risk	109
4.1 Literature Review	110
4.1.1 Structural Models	111
4.1.2 Reduced Form Models	112
4.1.3 Recovery Schemes	116
4.1.4 Outlook	118
4.2 An Overture to Bond Analysis	119
4.2.1 The Money Market Account and the Discount Factor	119
4.2.2 The Price of a Risky Zero Bond	121
4.2.3 The Price of a Risky Coupon Bond	122
4.2.4 Yields, Spot and Forward Rates	124
4.2.5 Default Probability Functions	126
4.2.6 Bootstrap Analysis	127
4.2.7 Bond Duration and Average Life	129

4.3	Functional Forms of the Term Structure	131
4.3.1	Affine Models	132
4.3.2	Parsimonious Models	133
4.3.3	Discussion	141
4.4	Modeling Recovery	143
4.4.1	Recovery of Market Value	144
4.4.2	Mixed Recovery	145
4.4.3	Discussion	146
4.5	Empirical Implementation	147
4.6	Concluding Remarks	150
5	Empirical Estimations	153
5.1	Empirical Model Comparison	154
5.1.1	The Nelson-Siegel Model	154
5.1.2	Two-factor Nelson-Siegel With RFV	159
5.1.3	The Weibull Model With RFV	163
5.1.4	The Gumbel Model With RFV	168
5.1.5	The Lognormal Model With RFV	171
5.1.6	Discussion	176
5.2	Results From Other Countries	177
5.2.1	Argentina	178
5.2.2	Colombia	183
5.2.3	Mexico	186
5.2.4	Turkey	191
5.2.5	Venezuela	194
5.3	Concluding Remarks	197
6	Credit Default Swaps	199
6.1	An Introduction to CDS	199
6.1.1	CDS Valuation	202
6.1.2	The CDS Basis	204
6.1.3	The Role of Recovery	206
6.2	Empirical Evidence From Brazil 2002–2003	211
6.2.1	Preliminary Data Analysis	211
6.2.2	No Arbitrage With Two Instruments	214
6.2.3	No Arbitrage With Three Instruments	217
6.3	Concluding Remarks	220
7	Conclusion	223
	References	229

Introduction

What will the world look like thirty years from now? Is the US dollar going to retain its position as the key currency? Will the pace of global integration with growing trade and capital flows continue, or recede in a continuation of historical cycles? How will the industrialized world interact with countries emerging from underdevelopment and competing for scarce economic resources? What might be the impact of disruptive events like natural disasters or civil unrest?

Given such commonplace uncertainties, it might seem astonishing that one could plan for the future. Capital markets, however, seem to do so as investors are willing to buy bonds from all parts of the world promising payments up to forty years into the future. Despite the recent push for long-term investment opportunities, should not caution be recommended, in emerging markets and elsewhere? Is it rationally justifiable to invest in emerging country governments, many of which have a shaky past but are hardly ever called to account? Do investors lend their money in the firm belief that the debtor will obey its repayment obligations?

Such qualms, though, might not be warranted. When things start to turn sour, investors who missed a timely exit quickly become engaged in an effort to recover some lump sum. Just as a country is unlikely to disappear from the world map, it is practically impossible for a sovereign to shake off all past promises. However, with the large number of actors in this game and the different interests at play, it might appear miraculous how markets assign a value to sovereign risk.

The credit risk literature has tackled the issue of pricing default risk by means of sophisticated calculus based on expectations theory calibrated with empirical data. By doing so, modeling the term structure of risk spreads became the focal point. Postulating that the loss

given default is a fraction of the market value helped to simplify matters greatly as the spread alone embodied all facets of credit risk. This dogma remained intact even for analyzing sovereign default risk where governments, in contrast to corporations, are immune to, and not liable for, bankruptcy proceedings.

On the one hand, today's scientific credit risk analysis has advanced to a level of abstraction beyond the grasp of many investors. On the other hand, market practitioners try to explain market movements with bits of new information arriving, often lacking consistency. However, both ways of understanding bond markets focus on bond yields and the term structure of risk spreads. This widespread practice is also reflected in credit risk management tools and the Basel II capital adequacy framework. The literature to date has not considered repricing of recovery value assumptions as an important feature of any market. The seminal paper by Duffie and Singleton (1999) helped to shape this attitude by advocating the recovery of market value concept. While handy and sufficient in most cases, this concept allows little flexibility in modeling recovery. Apparently, this accepted custom may soon change. Pan and Singleton (2005) acknowledge:

“Equally central to modeling the credit risk of sovereign issuers is the recovery in the event of default”.¹

The starting point of this study addresses some of the shortcomings of conventional credit risk frameworks. This is done by adapting traditional models to better suit the valuation of bonds and credit default swaps (CDS) subject to sovereign risk. The short history of sovereign bond markets and the development of ad hoc approaches to sovereign debt crises mark this study as an early contribution in exploring the peculiarities of sovereign risk valuation. This monograph is intended for investors searching for a toolkit when investing in emerging market sovereign instruments, scholars interested in alternative ways of evaluating default probabilities and recovery values, as well as other curious readers intending to fend off urban legends.

The rest of the introduction explains why this topic has grown so relevant in recent times. It motivates the subject from three different perspectives, from both the buy and sell sides, as well as from an academic point of view. Section 1.2 of this chapter defines the scope of the study, provides explanatory commentary on the nature of empirical studies, and explains the structure of the following chapters.

¹ Pan and Singleton (2005), p. 1.

1.1 Relevance of the Topic

Along with the increase in global liquidity and market integration during the last decade, new investment opportunities arose around the world.² Investors strove for higher returns and diversified risk, creating demand and liquidity for new financial products. Developing countries matched this demand, exploiting different channels to access much needed international capital. Regulatory bodies, such as the International Monetary Fund (IMF), and academia devoted much effort to overseeing, steering, and analyzing this development. These three pillars are used in the following to highlight the relevance of sovereign bonds for emerging countries today.

1.1.1 Relevance for Global Investment

Globalization includes the boundless flow of capital around the globe. Citibank was among the pioneers of truly global banking, trying to break the ties of the U.S. banking regulation and investing in developing countries. Soon, other banks joined this development.³ In the 1970s, a lending boom to emerging countries developed. Long-term syndicated loans to these countries became an important vehicle for recycling petrodollars.⁴ Bond markets also internationalized, creating all sorts of internationally placed issues such as eurobonds, Yankee bonds, Samurai issues, and global bonds.⁵ After the establishment of a market for trading high yield instruments of corporations during the 1980s, risky bond instruments found their way into the portfolios of institutional investors. In 1989, the Brady plan, which effectively securitized third world debt, paved the way for sovereign issuers into the high yield market. Today, external emerging market debt accounts for close to half of the high yield market (which has an estimated debt

² See Bekaert and Harvey (2003) and Erb et al. (1999).

³ See Friedmann (1977).

⁴ The pseudonym “petrodollar” denotes capital received by oil exporting countries after the oil price shocks. These funds were invested mainly in U.S. Treasury bills or transferred to American and Western European banks. Banks used these surpluses to increase their lending, especially to less developed countries, mainly in Latin America.

⁵ Eurobonds are bonds issued on the euromarket, i.e. the international capital markets, in a currency other than that of the country of issuance. Yankee and Samurai issues are denominated in US dollar or yen, respectively, and are exclusively sold in the U.S. or Japanese markets. Global bonds are issued on the international markets like eurobonds, but may be denominated in the same currency as the country of issuance. International bonds serve as an umbrella term.

volume of more than one trillion dollars). The share of sovereign issues of all emerging market bonds is about two-thirds.⁶

Despite this expansion, global capital flows proved volatile during the last 15 years. Financing the needs of emerging countries was put into the hands of the international investor community while the recipient countries initially lacked the economic and institutional structures necessary to effectively manage large capital inflows and outflows. Allocating capital globally also meant an exposure to changes in global liquidity, fluctuations in global risk aversion, and contagion. Cross-over investors welcomed emerging market debt as a substitute when domestic returns in industrialized countries were slack. The resulting volatility is reflected in Table 1.1, which shows a summary of annual capital flows to thirty emerging countries. Whereas net capital flows from official lenders turned negative due to loan repayments, net private capital flows grew strongly, but remained volatile.

More recently, however, the sovereign bond market underwent a process referred to as “secular maturation”. While fundamentals improved, the growing number of bonds outstanding established a relatively liquid asset class. The simultaneous emergence of a credit derivatives market substantially increased the smooth functioning of the bond market. This maturation enabled a widening of the investor base. Initially, only dedicated investors dealt in the market, exploiting their specific knowledge of emerging market bonds. In recent years, however, improving fundamentals and declining spreads have attracted a broader investor base. Large pension funds and buy-and-hold investors still make up the majority of investors while investors from other mandates (e.g., global bond funds) are being drawn into emerging market bonds on an “off-index” bet. Hedge funds make up about one-third of investments in emerging market debt and have become the marginal price setters.⁷

The maturation of the market affects not only the investor base, but the composition of emerging market debt as well. While external bond flows surpassed commercial bank loans by the end of the 1990s, this expansion is dwarfed by the growth of the domestic debt markets. Since 1996, the stock of domestic debt exceeds the amount of external debt in emerging markets and continues to increase at double digit rates. This trend might overcome the “original sin” problem of investors un-

⁶ These numbers are compiled from Merrill Lynch, “Size and Structure of the World Bond Market: 2002”, as well as JP Morgan Chase, “Emerging Markets Debt and Fiscal Indicators”, July 2005, and “Emerging Markets Bond Index Monitor”, June 2005.

⁷ See JP Morgan Chase, “Emerging Markets As An Asset Class”, October 2005.

Table 1.1. Capital flows to emerging market countries 1990–2004

Capital flows (US\$ billion)	1990	1992	1994	1996	1998	2000	2002	2004†
Net external financing	75	159	201	338	191	184	117	250
<i>Net private flows</i>	<i>35</i>	<i>121</i>	<i>175</i>	<i>334</i>	<i>139</i>	<i>187</i>	<i>120</i>	<i>303</i>
Net equity flows	17	47	99	127	133	152	119	177
Net direct investment	14	31	65	92	121	139	112	138
Net portfolio investment	3	16	34	35	12	13	1	39
Net private credit flows	17	74	76	207	6	35	2	127
Net commercial banks	9	29	43	123	-55	-1	-4	54
Net nonbanks (mostly bonds)	8	45	33	84	61	36	5	73
<i>Net official flows</i>	<i>40</i>	<i>38</i>	<i>26</i>	<i>4</i>	<i>52</i>	<i>-4</i>	<i>-3</i>	<i>-28</i>
IFI	10	9	5	7	38	3	8	-19
Bilateral creditors	30	29	22	-3	14	-7	-11	-9

Source: Institute of International Finance. Figures for thirty emerging market countries representing more than 90% of net private flows to developing countries. The official sector consists of the international financial institutions (IFI), i.e. the IMF, the World Bank, and multilateral development banks, as well as bilateral lenders, i.e. other governments.

(†) Estimate.

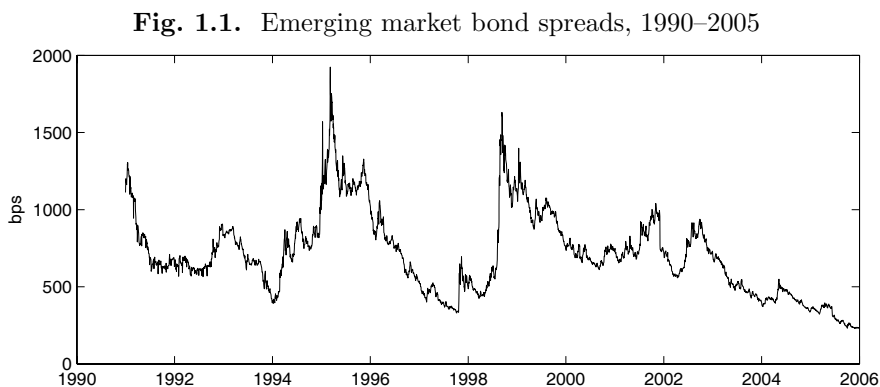
willing to buy domestic currency instruments, and at the same time reduce the danger of external imbalances. Moreover, investors are increasingly looking into new instruments offering exposure to sovereign risk. These include asset securitization and structured instruments, as well as derivatives such as sovereign credit default swaps.⁸ Given market incompleteness and a general lack of financial data on sovereigns, the pricing of such new instruments requires a profound knowledge of the nature of sovereign default risk, sovereign restructurings, and recovery values.

1.1.2 Relevance for Emerging Countries

Additional to these “push” factors, fundamentals in emerging countries have been growing stronger and present a clear “pull” effect. The recent contraction of sovereign spreads and the parallel surge in capital inflows are seen as a result of both effects. Figure 1.1 illustrates the course of

⁸ See Ketkar and Ratha (2001), Alles (2001), and Packer and Suthiphongchai (2003).

sovereign spreads as represented in the JP Morgan Chase Emerging Market Bond Index Global (EMBI Global).⁹

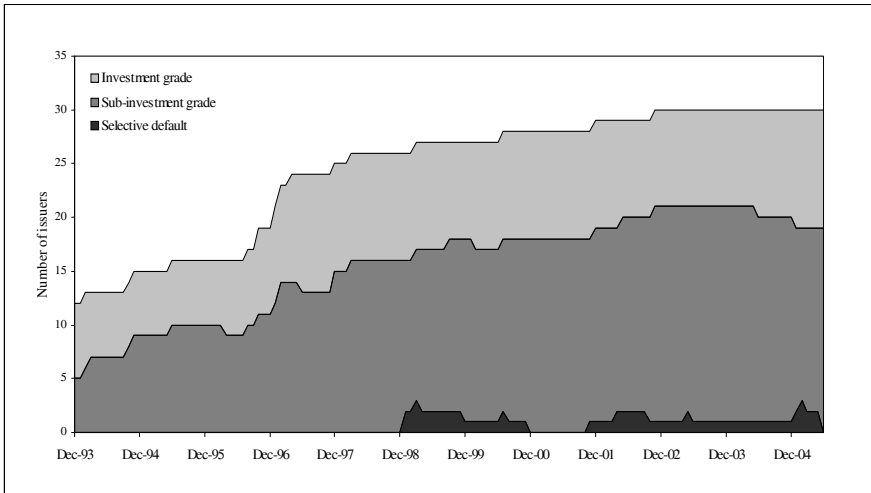


Source: JP Morgan Chase. Spliced history of JP Morgan EMBI and EMBI Global spread indices as provided by Bloomberg.

Learning from the crises of the last decade, emerging market governments now strive to improve their economies' external balances. When pooling all developing countries, the total current account balance turned positive in 2000 for the first time in decades. More countries have abandoned inflexible exchange rate arrangements—although some prominent examples did so only painfully—which had contributed to external imbalances in many cases. In recent years, more countries were able to accumulate a comfortable cushion of foreign reserves, extend the duration of their debt, and establish a smooth pattern of future installments.

However, as evident from Fig. 1.2, the share of sub-investment grade issuers within the emerging market asset class increased. The gradual improvement of credit ratings in some countries (in particular transition economies) failed to compensate for the large number of new entries with sub-investment grade ratings. The few success stories, such as the investment grade ratings of Mexico and Russia, were overshadowed by the number of debt crises and defaults, headed by Argentina's historical default in 2001.

⁹ The EMBI Global is a total return index for US dollar denominated debt instruments issued by sovereigns and quasi-sovereign entities of emerging countries. As of July 2005, the index included 184 instruments such as Brady bonds, loans, and global bonds from 32 countries with a total market capitalization of \$281 billion.

Fig. 1.2. Evolution of sovereign ratings in the EMBIG 1993–2005

Source: derived from Standard & Poor's and JP Morgan Chase. Standard & Poor's long-term foreign currency rating of sovereign issuers represented in the EMBIG in 2005.

As long as markets maintain their recently acquired resilience, governments will continue to exploit the full potential of sovereign bond markets. Expertise from debt swaps is used to pre-finance bond issues with short remaining maturities and eliminate old Brady-style debt. Accredited debtors utilize such exchanges to concentrate liquidity on fewer issues, and introduce clauses in their debt contract which strengthen the issuer's rights and ensure a more orderly workout process. The concept of "private sector involvement" (PSI), promoting equal burden sharing among all creditors in debt crises, and the G-8 stance towards debt forgiveness provide a stage for future bond restructurings. Judicial support for the controversial write-off in the Argentine restructuring has fueled this development. A sophisticated knowledge of past transactions presents good ammunition in face of the innovations the financial market is likely to see, such as collective action rulings or repeated restructurings. After the wave of soft restructurings in the Caribbean region in 2005, similar deals are expected to become the prevalent credit event for sovereign debt instruments. The exceptionally high recovery values in such transactions present a challenge to traditional valuation models for default contingent claims, such as bonds and credit default swaps. A large portion of this study is dedicated to the issue of recovery

specification, offering insight into the consequences of financial crises and sovereign restructurings for the financial markets.

1.1.3 Relevance in Academic Research

The valuation of risky debt instruments and their derivatives has received considerable attention in academic research. The most basic theoretical foundations laid by Black and Scholes (1972) and Merton (1974) have been extended to a comprehensive framework of theoretical and empirical elaborations on credit risk.¹⁰ Driving this development is the need for more sophisticated risk management, along with the expansion of the credit derivative market, and the advancement of structured products such as Collateralized Debt Obligations (CDO). Thanks to the Basel II Capital Accord, recovery risk now enjoys closer academic scrutiny.¹¹ At the same time, more theoretical and empirical work is dedicated to emerging market finance.¹² After close attention to sovereign debt contracts during the debt crises of the 1980s, a recent strand of the literature has been devoted to analyzing sovereign credit risk in traded instruments, foremost bonds. Chapter 2 provides a closer look at this expanding field.

The focal point of the empirical literature in this field, however, is the term structure analysis and its relation to the fundamentals. Given the existence of sufficient time series data on different bonds subject to the same credit risk, traded instruments issued by a sovereign present a well suited research object for this purpose. The financial literature has exploited these data by means of sophisticated stochastic term structure models, such as Duffie et al. (2003).

However, stochastic models are currently not suited to incorporate different concepts of recovery, thus foregoing an important aspect of sovereign restructurings. Empirical models, although often lacking the sound theoretical foundation of arbitrage free modeling, offer greater flexibility while presenting no lesser a fit to the data. By compromising on the no-arbitrage argument, the empirical part of this study yields weekly estimates of the recovery value implied in sovereign bonds and credit default swaps. This is intended to close a gap between the economic literature on fundamental determinants of crises and the asset pricing literature. The analysis assesses recent sovereign restructurings

¹⁰ See, among others, Ammann (1999), Cossin and Pirotte (2001), and Bielecki and Rutkowski (2002).

¹¹ See, as a collection of recent articles, Altman et al. (2005).

¹² See Bekaert and Harvey (2002, 2003).

through the lens of investors and implements the findings in a risk-neutral bond valuation model which differs from the current mantra of credit risk modeling. The empirical part yields estimates of unobservable variables which, in contrast to previous contributions, separate default intensity parameters from the estimated recovery rate. Such measures might prove useful for future economic research on fundamental determinants of sovereign solvency and liquidity which, up to now, frequently relies on mere simple indices (such as EMBIG spreads) of sovereign risk.

This study also differs from the existing literature by concentrating on countries and periods of financial distress. When default is close, the price of a bond is dominated by the legal rank of the contractual claim rather than the expected value of future cash flows. In the traders' lingo, bonds are referred to as "trading on a price basis" instead of a "yield basis", as traditional term structure models assume. By addressing this appropriately, a better fit of empirically observed bond prices is obtained. This evidence diverges from the irrelevance presumption of recovery implicit in the recovery of market value (RMV) assumption.¹³ Chapter 6 elaborates on this by illustrating the relevance of the recovery value when pricing credit default swaps during financial distress.

These points comprise the main contribution to the existing literature. The results will prove useful for scholars of sovereign risk and sovereign bond investors alike. While the empirical results are intended to give an idea of how sovereign risk analysis can be approached, the conceptual issues addressed will help to conduct a more sound analysis of sovereign investment instruments in the future.

1.2 Research Subject and Methodology

To provide the reader with some guidance on what to expect from reading this study, the following explains which topics are addressed in this study, which methodology is applied, and how the remainder is structured.

1.2.1 Subject

Sovereign risk refers to the possibility that a sovereign government (or its responsible entity) fails to fulfill a contractual obligation such as a

¹³ See Duffie and Singleton (1999).

debt contract. Any kind of breach or change of the contractual clauses are referred to as default. Such a broad definition of default does not necessarily correspond to economic insolvency or judicial bankruptcy known from corporations. Since a sovereign cannot go bankrupt in the traditional sense, the occurrence of default mostly goes back to some political decision. When the term default is used within this study, however, it is intended to carry a neutral meaning in the sense of a “credit event”. While it is true that default can lead to write-offs, a debt restructuring may in fact benefit debtors and creditors alike. Chapter 3 elaborates on this.

Unique to this examination is that the default risk is borne by a sovereign. This distinguishes this study from the large body of literature on corporate default risk. However, the concepts of modeling sovereign versus corporate credit risk are related. Although there is no bankruptcy court for sovereigns, the scope of sovereign immunity has always been limited, given the financial interests at play. In the past, such limitations were enforced by means of gunboat diplomacy or trade restrictions. Today, such measures have been replaced by applied law on the international financial markets.¹⁴ What remains unique is the sovereign’s *de facto* leeway in renegotiating the debt. This process is ruled by political realities, rather formal legal principles. In comparison to corporate defaults (which occur in larger numbers and provide a comparatively homogeneous data set on historical default and recovery rates), this attribute presents a challenge to any empirical assessment.

The study of international sovereign bonds sheds light on the main aspect of sovereign default risk. Creditworthiness on the international financial markets is regarded as a crucial condition for participation in the global economy. The importance of international capital flows for growth and development is an acknowledged fact in both theoretical and empirical economics. The credit standing of a country’s government thereby provides some limits on the creditworthiness of other economic entities located in that country. Emerging market governments therefore have a strong incentive to demonstrate their qualities as debtors and compete for international capital. This contrasts sovereign debt issued in domestic capital markets (i.e. within those countries and under domestic legislation), which are typically less mature and vary in the degree of their rule of law. Compared to domestic markets, this study

¹⁴ Certainly, some caveats apply. While it is possible to reach a judicial ruling against a sovereign in specific cases, the main challenge to the plaintiff consists in the enforcement of such a ruling. Andritzky (2004*b*) contains a short review of the legal issues at work and provides further references.

of the international bond markets enjoys the virtue of homogeneity in the research subject. Global bonds, i.e. bonds sold in an international investor universe under the law of an acknowledged foreign financial center, are issued under fairly comparable contractual terms and are traded among a comparatively homogenous community of investors. Since sovereign debtors often borrow large sums, their international bonded debt is often split into several issues. While there are differences in terms of maturity, coupons, and amortization, these claims share the same seniority, i.e. rank *pari passu* in case of a credit event. Market prices of global bonds therefore contain rich information about sovereign risk and facilitate the comparison between countries. This focus allows for an analysis of the following questions:

1. What were the intentions and the result of recent crisis resolution efforts which involved sovereign debt problems, given the idiosyncratic nature of their circumstances?
2. What are the effects of sovereign restructurings from an investor's perspective, both in terms of returns on investment and implications on modeling recovery?
3. How can sovereign default risk be modeled, and what information can be extracted from the market prices of bonds?
4. What is the performance of such a model in comparison to traditional models when applied to empirical data?
5. To what extent does the recovery assumption matter for pricing credit default swaps, especially during distress?
6. What information about the expected recovery can be revealed from market quotes of credit default swaps?

Concentrating on these questions requires a strict demarcation of several considerations that cannot be addressed in this study. The focus of this study suggests limiting the empirical analysis to debtors who embody considerable risk of default. While this does not question the general applicability of the model developed here, insightful empirical results can only be obtained when bond prices are subject to a substantial threat of default. A second limitation is dictated by the availability of data. While some countries (independent of their size) have a large number of bonds outstanding, others might use different channels of financing and therefore do not find their way into this analysis. Furthermore, the quality of the financial data is not always sufficient, as trading volumes are thin or financial time series were not obtainable for this study.

The cumulative effect of these aspects motivates the country selection for the empirical parts in Chaps. 5 and 6. The analysis is conducted

for fixed coupon bonds denominated in US dollars. This is the dominant currency of denomination, and most issuers (except for some Eastern European states) denote the largest portion of sovereign bonds in dollars. However, given a sufficient sample of euro, sterling, or yen denominated issues, the proposed model can be applied in a similar fashion. A mixed sample of bonds of different denomination requires disentangling currency risk from bond spreads though—an exercise beyond the scope of this study. Floating rate notes make up an insignificant portion of the market, but could be modeled in a similar manner. Due to their declining importance, this study also foregoes the analysis of Brady bonds.¹⁵ Semi-sovereign issues, such as bonds from public companies or bonds with sovereign guarantees, may also show significantly different characteristics, and do not belong in this study. Only with these very strict limitations was it possible to achieve a homogeneous sample of sovereign bonds. It also serves to reduce potential distortions originated by trading illiquidity or market segmentation, topics which will appear as side aspects only.

1.2.2 Methodology

For most of this study, the research approach is straightforward and laid out in the introduction to each chapter. Solely for Chaps. 5 and 6, which contain empirical estimations, the following thoughts highlight the benefits and limitations of such an endeavor.

The theory of asset pricing provides the foundation to derive the present value of future payments under the veil of default risk. Even after considering fundamental rules of stochastic calculus and no arbitrage, there remain several ways to value claims subject to default risk.

While this will be discussed in depth in Chap. 4, the following focuses on the implications of interpreting the empirical results. Empirical estimates are known to be a test of both the respective hypothesis, as well as the model applied with all its underlying assumptions. Sound theory can suggest a pricing model, arguing that this is the true way to determine fair asset prices. This is called the normative view. If consensus exists on such a unique model, it is justified to determine the endogenous variables from asset prices. The outcome reflects the positive view of things. As soon as there are differing views on what the “true model” should look like, however, the result of an empirical calibration might become the product of its assumptions.

¹⁵ On Brady bonds, see instead Bhanot (1998), Buckley (2004), Claessens and Penacchi (1996), Izvorski (1998), Pages (2001), and others.

Reduced form models of credit risk, as applied in the empirical part of the study, are particularly vulnerable to these concerns. The decisive parameters of credit risk frameworks such as default probability, recovery expectation, and risk aversion, present unobservable parameters which can only be proxied by some measurable variable. As long as market participants do not share a common view on either the model parameters or on the model itself, market prices might give only a blurred picture of what theoretically is considered as credit risk.

A proof of plausibility for empirically estimated measures of credit risk is therefore advisable. The sound theoretical foundation of the pricing and estimation model, together with a check of the underlying assumptions, is a useful starting point. Furthermore, some guidance can be derived from historical experience, even if past events cannot directly be compared to expected future events. Chapters 2 and 3 provide this background. Another approach is to determine the empirical fit of the model with the data, an aspect highlighted in Chap. 5.

This caveat of empirical research is stressed in the face of missing benchmarks of credit risk parameters. The term structure curve of credit risk spreads, for example, is an abstract measure contingent upon a set of assumptions. Making justified manipulations to these assumptions might yield a different, perhaps unfamiliar curve which can nevertheless be similarly plausible. This has to be kept in mind for the empirical estimations in this study. The plausibility of a different view on modeling the loss given default is a renunciation of current conventions. These considerations, however, are warranted by economic intuition, historical experience, and market practice.

1.2.3 Structure

This monograph has seven chapters. After this introduction, Chap. 2 reviews the history of sovereign lending and default. The first part focuses on bond lending a century ago, showing how sovereign default and bond restructurings were handled then. Historical evidence provides early examples of bondholder coordination and collateralization, features which are discussed again today. The second part reviews the development which led to the new age of bond lending in the 1990s, and offers a short outline of recent financial crises in emerging markets. Furthermore, Chap. 2 reviews the literature on sovereign lending, financial crises, and the international financial institutions. The section presents current theories, positions this study within the literature, and offers further reference.

Chapter 3 analyzes recent restructurings of sovereign debt—such as the Argentine mega-restructuring in 2005—from the point of view of an investor. The empirical evidence supports the distinction between “soft” and “hard” restructurings, depending on how advantageous the restructuring deal is for bondholders. The heterogeneity of such a workout deal is reflected in the wide range of resulting recovery values.

The following part links this finding to existing bond pricing frameworks, considering two kinds of recovery assumptions. Chapters 4 and 5 are devoted to the analysis of global sovereign bonds issued by large emerging countries. In a first step, Chap. 4 gives an introduction to financial calculus and elaborates on ways of modeling sovereign default risk. For modeling recovery, a framework mixing the recovery of market value (RMV) and the recovery of face value (RFV) approach is suggested. Applying different variations of term structure models, Chap. 5 evaluates these approaches in a case study of Brazilian global bonds. The next section extends the analysis to half a dozen countries. The results provide a set of estimates on implied parameters, such as the risk-neutral default intensity and recovery rate.

Chapter 6 advances into derivative markets, showing the relevance of recovery assumptions on the pricing of credit default swaps. An analysis of the Brazil crisis 2002/2003 yields a differentiated picture of expected recovery values, showing why protection becomes so expensive when soft restructurings are the prevalent path to crisis resolution. A joint model of bond prices and credit default swap spreads is used to extract market implied recovery values, distinguishing RMV and RFV parameters.

The last chapter, Chap. 7, presents a synthesis of the results.

Sovereign Lending and Default

“Countries don’t go bankrupt.”

This is a famous saying in the financial community. Despite waves of sovereign defaults and restructurings, the statement is still true at its core. The reason for this is to be found in the concept of sovereignty, the prevalent principle of today’s world order. Within sovereignty, two complementary dimensions are inherent, the internal and the external dimension.

The internal dimension of sovereignty is constituted by the supreme authority of a country’s political body. The ruling institution—constitutional governments and parliaments, dictators and juntas, monarchs and the like—assumes the power of legislative actions, fiscal budgeting, and overall economic policymaking. This authority embraces the decision to reach out to international capital markets and likewise secures sufficient revenues for debt service. Thomas Hobbes drafted this notion of unlimited internal power, or his “Leviathan”.¹ In theory, the Leviathan can exercise the power to raise sufficient means for external debt service: he might introduce capital controls, increase taxes, nationalize the corporate sector, or pledge the country’s assets to foreign creditors. In very few areas the sovereign’s discretion is limited by conventions of international law (for instance human rights, encompassing only basic economic privileges such as property rights), but weak enforcement renders the scope of protection even smaller. This is why countries can rarely go “bankrupt”.

The external dimension of sovereignty provides protection against foreign influence. This idea of non-intervention in national affairs was commenced by the Peace of Augsburg in 1555 (“*cuius regio, eius reli-*

¹ See Hobbes (1968).

gio”) and later the Peace of Westphalia in 1648. Today, Article Two of the United Nations Charter enshrines the “political independence and territorial integrity” and leaves few exceptions justifying interventions.² This leaves few levers for bondholders of sovereign debt against repudiation. However, the lack of internationally agreed rules on sovereign lending, default, and restructuring can be seen as logical complement to the lack of effective protection of human economic rights. This aspect notwithstanding, external sovereignty today is confined by the denial of absolute sovereign immunity. Diplomatic immunity, as manifested in the Vienna Convention of 1961, excludes sovereign acts from any foreign legislation (“*ius imperii*”). International debt, even when issued by a sovereign entity, is subsumed as business activity (“*ius gestionis*”), enjoying limited immunity. National law, such as the U.S. “Foreign Sovereign Immunities Act” of 1976 or the British “State Immunity Act” of 1978, has fleshed out this notion.³ However, little legal certainty has made litigation against sovereign debtors a costly endeavor with few chances for success.⁴

Although the decision to default and restructure sovereign debt is, seemingly, at the issuer’s discretion, political pressure from the outside plays a significant role. Whether it is the U.S. Treasury pushing for a bail-out of Mexico in 1994, the IMF agreeing on Turkey’s aid package, or Venezuela’s Hugo Chávez coming to the aid of his fellow South American leaders by buying their bonds, international politics are always at the forefront of crises. Sovereign bond investors and their interests play a subordinate role in this play, at least when lacking a sound command of lobbying power. The threat of litigation has hardly impressed any debtor government. Domestic sovereign and sub-sovereign bonds, in contrast, are very distinctive in this regard.⁵ They underly primarily the domestic legislature (whose idiosyncratic nature hampers cross-country comparisons), although domestic markets are increasingly interlinked with international markets. While holders of international sovereign

² However, such doubtable interventions have frequently occurred since the end of the Cold War, although never in response to sovereign debt repudiation. Indeed, quite the reverse causality prevailed when Pakistan faced economic sanctions in response to atomic tests, forcing the country into a restructuring of sovereign bonds in 1999.

³ Waivers of immunity to foreign creditors, common in sovereign bond contracts, enforce only this aspect and, as of today’s legal doctrine and judicial practice, do not undermine diplomatic immunity.

⁴ See Andritzky (2004*b*). However, returns on litigation, when successful, can be substantial. See Singh (2003*b*).

⁵ On the restructuring of subnational debt see Schwarcz (2004).

bonds are off the reach of internal sovereign power, holders of domestic bonds are not. Their claims can theoretically be repudiated by the legislature in the wink of an eye.

This chapter is dedicated to exploring the past and current states of sovereign debt by looking at its history and reviewing the theoretical and empirical literature. Knowledge of past lending arrangements and recent crises helps to understand the manifoldness of this topic, especially since the patterns of lending and crises evolved over time. The theoretical scientific literature provides common frameworks which strive to reproduce the main characteristics of sovereign lending. Some underpinnings are provided by the empirical literature, although methodological problems and the idiosyncratic nature of events pose serious caveats. While the review in Sects. 2.3 and 2.4 focuses on the economic literature, more specific references to the asset pricing and credit risk literature follow in Chap. 4. The literature specific to sovereign restructurings and credit default swaps is discussed in the respective chapters (see Chaps. 3 and 6).

2.1 The pre-1990 Episode of Sovereign Lending

Although today's modern global sovereign lending is somewhat unique, it would be negligent to assume that there is nothing to learn from the past. Foreign lending (in the form of both bonds and loans), sovereign default, and sovereign restructurings occurred before, even in the 19th century (see Fig. 2.1). Wave-like patterns of international lending and default were present then and now. The following presents a short wrap-up of the events of that time.

2.1.1 Infancy and the “Golden Age”

The first well documented wave of lending in modern times occurred in the post-Napoleonic era of the 1820s with flows especially directed to newly independent countries in Latin America. A wave of defaults followed soon. Another high point was reached in the 1850s with subsequent defaults concentrated in Latin America and the Mediterranean. The period between 1870 and World War I marked the truly “golden age” of sovereign lending, with significant international capital flows into emerging markets and a degree of financial integration only regained again a century later.⁶

⁶ See Lindert and Morton (1989), Sachs and Warner (1995), Aggarwal (1996), Bordo et al. (1998), and O'Rourke and Williamson (1998).